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Abstract

After a detailed history and definition of Computer-Assisted Instruction (which identifies drill and practice, tutorial, and problem-solving activities as comprising CAI), the development and implementation of a college level computer based multimedia physics course is described as an example of tutorial activities in CAI for those interested in applying CAI to adult education. Special emphasis is placed on the base line student performance information, multimedia materials, staff differentiation, field tests, a systems approach, and cost effectiveness plans which were used in devising this program. An overview of computer hardware and software problems, such as cost (especially with reference to the advantages of centralized and decentralized systems), type of terminal device (such as the cathode-ray tube), and computer control of multimedia instructional devices is presented next, along with a brief indication of the problems involved in dealing with computer manufacturers and in training employees. Finally, computer applications which are being investigated at Florida State University are reviewed with reference to their implications for adult

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CAI CENTER

TECH MEMO

AN OVERVIEW OF COMPUTER-ASSISTED INSTRUCTION FOR ADULT EDUCATORS

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ABSTRACT

This paper is an introduction to computer-assisted instruction for persons working in the area of Adult Basic Education. There is an extensive discussion of the development and evaluation of a tutorial CAI program. CAI hardware and implementation are also discussed. A variety of prototype computer applications, which have been investigated at Florida State, are described along with their implications for Adult Basic Education.

An Overview of Computer-Assisted Instruction for Adult Educators[1]

Walter Dick

INTRODUCTION

I am happy to be here, not only in terms of the opportunity for presenting an overview of computer-assisted instruction (CAI), but also for this opportunity to find out more about the activities at North Carolina State (NCS) related to the use of computers in Adult Education. To my knowledge, the NCS group is the only one in the country which is dealing exclusively with this type of application. The implication is that my comments on CAI will not be based directly on an extensive amount of work with adults, but rather on the experiences which we have gained at Florida State working with a wide variety of students.

I have looked over your program for the past week and find that you have had a series of outstanding speakers on such topics as programmed instruction, multi-media programming, the Systems Approach, and methods of evaluation. I think that this is a logical point in your program to introduce the concept of CAI, and to try to assess its potential role in Adult Basic Education. Perhaps the most effective way to provide you with an overview of CAI and to give you an orientation to our thinking about the problems associated with CAI, is to simulate a visit through our CAI Center at Florida State. I have brought along a brief film about one of our projects

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[1]Paper presented to the National Institute for Adult Basic Education held at the North Carolina State University, Raleigh, North Carolina, July 28, 1969.

in order to illustrate the nature of our CAI Center. Following the film, I will discuss some of the questions which are often raised by visitors to our Center, and try to anticipate questions which you might have about CAI. In the discussion, ideas will be presented which are based both on data and on opinions, and I will try to distinquish between the two as I go along.

At this point, let me simply show you the film on our activities. It is based primarily on a project in collegiate physics which we have implemented and completed over the past two years. It will give you some idea of the activities of students as they interact with the CAI equipment. (At this point, the film "The CAI Story" was shown.)

Perhaps the best place to begin this presentation is to attempt to define "computer-assisted instruction." However, this is practically an impossible task, since it seemingly has multiple definitions, which are related to a variety of applications of such systems. It is interesting to note that historically CAI was defined by the IBM Corporation. IBM has not only dominated the field of CAI, but has, in fact, generated the label, CAI. The original terminology for this interaction between the student and the computer was called "computer-based instruction." But after a brief upheaval in the IBM Corporation in the early 60's, the term emerged as computer-assisted instruction, denoting that it simply was a supportive tool for instruction as opposed to the primary source of instruction. However, the use of computers in education is growing rapidly, and CAI is taking on even broader connotations.

Perhaps the best functional definition was derived by Pat Suppes who identified three kinds of activities as comprising CAI. These were namely, 1) drill and practice activities, 2) tutorial activities, and 3) interactive or problem-solving activities. Almost all indications from R and D course development projects and discussions in users groups would indicate that the primary area of interest has been in the tutorial mode of instruction. This mode clearly represents the type of teaching which is currently available in programmed instruction. For example, a content area is systematically analyzed, and performance objectives are developed. The student receives all of his instruction in a particular topic via an interactive dialogue at the computer terminal. This type of instruction is prototypic of the efforts at Penn State, Texas, University of Illinois, and, I would say, of Florida State to a certain extent.

Turning to the other two types of CAI, the drill and practice type of activity is best represented by Patrick Suppes' activities at Stanford. Suppes has provided mathematics and spelling materials to students by means of teletype terminals which are connected by telephone lines to a PDP/10 system. The achievement ranged from good to outstanding in these curriculum areas by using the computer primarily as a presentation/correction device. The drill and practice materials contain information which the student has previously encountered in the classroom, but needs continual practice, immediate feedback, and repeated presentations of difficult material in order to achieve these basic skills. Suppes has been criticized for what some people consider a trivial use of CAI. On the other

hand, I would argue that he has successfully implemented a new CAI system and demonstrated a degree of effectiveness. The system is currently being utilized by approximately 5,000 students across the country, and is receiving wide acceptance. In this respect, I would consider Stanford's activities to be quite successful and consider Suppes' activities quite valid.

The third area within the Suppes definition of CAI activities is that of problem solving. CAI problem solving subsumes the activities of simulation or gaming. Gaming and simulation are often used when a student already has the basic information about a topic. The student is required to utilize this information in his interaction with the computer in order to derive a deeper understanding, if I can use such words, of the concepts which he has learned. Economic games, business games, and medical diagnosis simulations are all prototypic of this type of CAI. Games and simulation are generally very difficult to program, but have a great deal of intuitive appeal. This area has probably been least pursued in terms of its learning potentialities for the student.

Since the tutorial mode of instruction is perhaps the one which is most familiar and prevalent in CAI, it is worth taking some time to discuss in some depth the FSU Physics Project which was portrayed on the film. While neither our developmental techniques, nor necessarily our outcomes, are prototypic of the general tutorial use of CAI systems in the country, there are a number of generalizations which we have evolved from this project which may have a great deal of bearing on how you might consider the use of the computer in Adult Basic Education.

The computer-based multi-media physics course was funded by USOE in order to provide us with support to explore the possibility of developing and evaluating an automated, collegiate physics course. The course which we implemented for non-science majors was one of three science electives which all students in the basic studies program at Florida State could select. Approximately 300 to 700 students enroll in the course each quarter, and it was from this group that we obtained our students.

When the project began, we undertook two activities which proved to have high payoffs. First we video taped the lecture presentations of the professor who was responsible for the classroom version of the course. We utilized this in order to do an analysis of the content of the course and to determine the information which was being presented to the students. These tapes proved to be invaluable to the CAI writers at a later date. In addition, in order to show some immediate activity on our computer system, we secured copies of the course tests, analyzed the types of skills which were required in order to solve the questions in these tests, and analyzed the homework problems which the students were required to do. We set up a series of CAI homework review problems which were made available on an optional basis to the students in the regular physics course. The students were offered an opportunity to come to the Center to receive homework and test-like questions which were similar to those they would be receiving on the test. The computer supplied answers to the questions as well as remedial feedback and reinforcement. The first time we entered the class of 700 students and offered this service to them, approximately 30

volunteered to participate. The second time, there were about 75 or 80 participants. By the time of the final examination, our Center and its terminals were saturated for the preceding week; approximately 280 students were processed. This was tremendously encouraging to us, in that the growing numbers of students who attended indicated that at least in their minds, we were providing a service which was of some importance to them. And we gathered a great deal of data which showed us where the students' problem areas were with the physics concepts.

We used the video tapes and this base-line student performance information to then go about the development of the individual lesson sequences. I think it is important to note from these early activities that, in general, it is probably unwise to develop a CAI course by first programming lesson one and then lesson two, then lesson three, etc. without presenting these materials to your students, getting their reactions, and their performance data, and gathering some kind of baseline information about their current level of capability while beginning the actual programming. And I think a great deal of time is wasted in preparing instructional sequences, such as extensive remedial loops, which are eventually of no value to any significant number of students.

Our second decision was to make the CAI physics course a multi-media course, i.e., not to depend solely upon the computer as the presentation device, but to take advantage of the excellent films which have been developed by the Physical Science Study Committee and by a professor at Florida State who produces film loops on experiments usually carried out by the instructor in the classroom.

We also developed audio tapes which were, in essence, compressed versions of some of the lecture presentations. We utilized, of course, a textbook which the students were required to read prior to starting a lesson. And we used the CAI system itself for monitoring and guiding the students throughout the lessons and for continually reviewing their progress in both the testing and review mode, and providing remedial information to them. This approach to the development of the CAI course optimized the resources which were available to us and provided us with a realistic usage of the CAI system.

A third important aspect which evolved quite early in the physics project was that of staff differentiation. I think this is a critical concept in the development of CAI materials. We utilized the services of several professors from the Physics Department at Florida State to provide the overall conceptual leadership in the development of the instructional materials. This was a role which they played very, very well. However, it would have been foolish of us to expect that we could obtain a great deal of their time in actually writing, coding and debugging all of the instructional materials. These professors are busy with important research projects, and contrary to some of the early IBM thinking, there is no payoff at the present time for a professor to develop CAI materials. Therefore, we hired three physics writers, one with a Master's Degree and two with Bachelor's Degrees in physics, who were very competent and were interested in the instructional process. They translated the general conceptual views of the physics professors into meaningful, instructional materials. In this process, they

interacted with the psychologists who were available in our Center and with people who were completely informed as to the capabilities of the computer system itself. These writers were the backbone of the actual development of the instructional materials which were implemented both on the computer as well as on the other media.

When materials were completed, they were handed to what we have termed "coders." These are people who are expert in the CAI language utilized by our computer and they actually entered the information and did the first debugging of the instructional materials. We obviously also had computer operators who ran the CAI system, computer programmers who developed a data analysis system for us, and proctors whose role it was to work with students when they came to the Center. These people, along with secretarial help, characterized the type of staffing which we utilized in the project. I cannot emphasize too heavily the necessity for having such role differentiation and for maximizing the utilization of people's capabilities where they can contribute most significantly without dissipating their time and energies across a wide range of tasks which would take too much time to learn and master.

During 1968 and 1969 we conducted three field studies in order to evaluate the multi-media computer-based physics course. Our students were sampled on a volunteer basis from the students regularly enrolling in the Physics 107 course at Florida State. The administration granted the CAI students the regular three credits for this course, with the stipulation that the students take the regular examinations which all the other students in the course would be taking. In the first study we had twenty-three students who participated and took

their entire physics instruction via CAI. The outcome was a significant superiority in the final grades of the students who took the course by CAI as compared to a matched sample of students from the conventional course. There was also a considerable time savings. However, we did not witness any great acceleration of the students' pace through the materials. In general, they came to the Center to take two or more lessons at one time and primarily scheduled their time in the Center when it was convenient in relation to their other course responsibilities.

The second study was conducted after the CAI materials were revised. We achieved approximately equal performance between the CAI group of 37 students and a matched group in the conventional course. Again, there was approximately a 15% savings in time.

For the third field study, we removed the films and most of the audio tapes from the course presentation so that the course was only two-thirds the length it had been in the past. The other one-third of the course time for CAI students was spent discussing topics related to the current physics course and extending these ideas to more advanced areas. The results of this study indicated that those students who completed all 29 CAI lessons performed equally well on the final examination as those students in the conventional course. In addition, they did significantly better than a matched sample of students on an examination constructed by their own professor.

The outcomes of these studies make a number of outcomes quite clear to us. The students see the major benefit of CAI in terms of its self-pacing aspects. There is also a great sense of working along with a tutor. Students will sometimes, on their first

interaction with the CAI terminal, conclude that there is really a person at the other end of the line who is responding to them and that it could not conceivably be a machine. Most students, after some exposure to the system, seem to develop a very personal feeling toward the computer.

As a part of this physics project, we attempted to evaluate the cost benefit of CAI and we immediately encountered the problem of demonstrating the value, in a monetary sense, of enhanced learning. In a university system, budgets are generated in terms of credit hours and not grade points. Therefore, it is difficult to place a monetary value on a A as opposed to a B, or to determine the value of achieving ten objectives as opposed to five. However, the final analysis seems to indicate that the cost of CAI will continue to go down and hopefully the effectiveness of CAI will increase within the next decade. I will return to the problem of costs in a few minutes.

Finally, it is apparent that the homework problems which were utilized by the students prior to their various examinations appeared to contribute approximately 10% gains to their learning outcomes on the examinations. This appears to be a potent and very rewarding tool for the students and we are considering the application of this particular aspect of CAI in other areas.

In summary, we discovered and evolved a number or propositions about CAI curriculum development which you may wish to consider. The first of these generalizations deals with the "Systems Approach." We evolved and developed our own version of the "Systems Approach" as we progressed through the project. We did, in fact, analyze our

task and our content. We did get to know the entry behaviors of our students. We did formulate our behavioral objectives primarily on the basis of the behaviors expected of the students on the tests. The instructional strategy was one of utilizing a variety of instructional media in order to try to optimize the capability which was represented by each medium. We evaluated as often and in as positive a fashion as we could.

I know you have already had a presentation on the "Systems Approach" and, therefore, should be familiar with the terminology which I am using. I hope it was emphasized, and I would emphasize, that you can learn the jargon in a relatively short period of time. On the other hand, it is a very difficult and complex task to seriously follow all the guidelines and procedures which such a model suggests. However, we feel that in curriculum development efforts it is worth this effort, and there is beginning to evolve some empirical evidence to support this position.

The second generalization is that the higher the terminal criterion performance which you expect of the students for whom you are preparing materials, the more difficult will be your programming of the course plus the more complex will be the instructional strategy which you will have to employ. These complexities will complicate the development of your instructional materials.

Third, we are convinced that CAI is a tool which should fit within a curriculum and within an instructional setting, that is, it should not carry the entire instructional load but should be a part of a multi-media resource. One concept to keep in mind, however, is

that the greater the variety of media which you choose to employ, the more complex will become the logistics for the student and the more difficult the total implementation process.

And lastly, to emphasize a point made earlier, you should be constantly aware of the role differentiation which seems to have high pay-off in terms of carrying forward a curriculum development project. In other words, the burden should be spread among a number of people who have special aptitudes or training for the various tasks. Specialization within a CAI project undoubtedly increases your probability of success.

I would now like to talk briefly about the other side of the coin in CAI, namely, the hardware or computer aspects of it. To educators, the computer is probably the least interesting, and certainly the most costly, aspect of computer-assisted instruction. In principle many of the computers available today from numerous manufacturers can be utilized for computer-assisted instruction. The primary reason why more different manufacturers' computers are not being used for CAI is the lack of CAI operating systems. By this I mean the software required to assemble the course material and to provide it in a time-sharing mode with a number of student terminals, is not available or is costly to develop. The CAI computer system which is most predominately found in the United States at the present time is the IBM 1500 System. The currently available versions of the 1500 System have an 1130 central processing unit which rents for less than two thousand dollars a month. However, the peripheral equipment required to complete the CAI System brings the total monthly cost to anywhere from $8000 to $12,000 depending upon the variety of audio-

visual devices which may be added. Clearly, this cost is prohibitive in an operational setting at the present time. In nearly every CAI Center, the federal and state governments are paying the bill in order to provide researchers with the opportunity to explore the potentials of CAI.

There are at least two solutions to this problem of CAI equipment costs. Perhaps your first inclination would be to add many, many more terminals to a computer system in order to drive down the per hour cost per student. This concept has received some attention. The IBM Corporation is now making the Coursewriter CAI operating system available on its 360/40 computer system and as such should be capable of driving more than 32 terminals. However, the cost of the terminal devices are still prohibitive. Several feasibility studies have been compiled for the U.S.O.E. for CAI systems which would serve 100,000 students in a metropolitan area and would have 1000 terminals. The University of Illinois is currently attempting to develop a CAI computer system which would drive 4000 terminals. I have no doubt that in time these systems will become operational. However, one of the primary costs involved in such large systems is not the central processing unit but the telephone line charges. Most of these systems require one telephone line per terminal, a cost item. The second cost is in the terminal device itself. The CRT's or TV-like terminals on the 1500 System sell for over $5000 a piece. For a simple 32 terminal system the outright purchase cost for the terminals alone would be over $100,000.00. For computer systems with hundreds and thousands of terminals the cost would become extremely high. However,

the University of Illinois again is working on a low cost plasma screen terminal which may become operational in the near future. This terminal device should overcome some of the current technological and cost problems associated with CRTs.

The other point of view in terms of future CAI hardware is one which few people are espousing, but we at Florida State feel has distinct possibilities. That is, providing CAI on a small computer which is a stand-alone, locally controlled, reasonably priced computer system. The results of our analysis indicates that such systems could be made available for approximately $165 to $185 thousand dollars, or at a rate of approximately $15 to $20 per student per year. This system would include the CAI operating system and 16 to 32 student terminals. The cost for this proposed system would be approximately one third that of the cost to purchase the current IBM 1500 system. We also speculate in this regard that as time goes on, two economic hypotheses will become reality. First, although the decrease in the cost of computer central processing units will begin leveling off soon, the cost of the peripheral equipment and terminal devices will <u>continue</u> to go down. Likewise, it seems a fact of life that inflation will continue to drive up the cost of instructors' salaries--that fixed item which represents anywhere from seventy to eighty percent of the educator's budget. These two trends argue for the enhanced econonic feasibility of CAI.

In addition to the problem of computer costs, there is the problem of what computer and what terminal devices to acquire. I would like to describe briefly one study which we have done at Florida State, which in this regard, may have particular relevance to the field of adult education. This study began as a rather mundane comparison of student

performance on a programmed text and performance on a similar program presented by CAI. Although this is not a very startling idea, there is remarkably little evidence of this type of comparison being carried on. It evolved from a graduate student project in which the student's PI text was utilized as the source material for the development of an enhanced CAI course package. The package consisted of about forty minutes of instruction on the topic of significant numbers. The topic is usually taught to eighth graders. The study was run once, the data analyzed and then replicated under better experimental conditions.

The primary finding of the study was that with high ability eighth grade students, there was essentially no difference in their performance in terms of utilizing CAI or PI. However, the performance on the final examination of the low ability students who used CAI, was significantly less than that of the low ability students who utilized the PI text. As a matter of fact, on a retention test the low ability students using programmed instruction actually scored better than the high ability students using programmed instruction. The important point here is that the device which these low ability students were using in the CAI treatment was the cathode-ray tube terminal. The program did not provide the student with an opportunity to review in the sense that a student could review a PI text by flipping back the pages. Information appeared on the screen, the student responded to it, and it was gone. The results seem to indicate that for low ability students there may be a greater need for memory aids or actual hard-copy printouts. Perhaps this result might generalize to adults who use the cathode-ray tube. Although it is a marvelous device for very rapidly

presenting information to a student, the CRT may not be optimal for those with low ability. It may, in fact, handicap their memory of the instructional material.

One final note on the utilization of a variety of instructional devices which are driven by the computer. One point of view would argue that in order to maximize learning we must have all instructional devices under the control of the computer. That is, we should have a random access audio device, a cathode-ray tube, a light pen, a keyboard, an image projector, and even a TV and other display devices under computer control. It has been our feeling based on some experience at Florida State that we prefer to utilize only the basic CRT-keyboard-light pen capability of the CAI system and forsake the more esoteric devices. This decision has been reached on the basis of 1) the cost of such additional devices and 2) a genuine questioning of the trade off or benefit which is to be derived from such devices. We have found, for example, that students as young as junior high age are quite capable of utilizing a Kodak carrosel projector. We have also utilized flip pads which contain graphics plus work books for additional writing activities. You will recall also that we utilize cartridge film projectors as well as 16 mm projectors in our CAI physics course. None of these devices were under computer control. We do not feel that the student has been handicapped in any way because of this situation.

In summary, the intellectual and economic battle will continue over the next several years over the desirability of large computer networks for CAI as compared to small, stand alone, multi-purpose computers. The functional characteristics of the instructional terminal will also become more important.

If you were fortunate enough to have the funding available to actually implement CAI, there would be a number of pitfalls which should be avoided or at least prepared for. In a symposium held at the National Society for Programmed Instruction convention, in Washington this past Spring, Bill Richardson from the Montgomery County Public Schools, John Ford from the San Diego Naval Training Laboratory and I presented papers on the problems of CAI implementation. If you have interests in this area, you may write to any of the three of us for copies of our papers which represent our perceptions of the problems in implementing CAI. (See FSU, CAI Center Tech Memo Number 1, May, 1969.)

However, let me briefly indicate the two primary areas of concern which I have identified. The first occurs in dealing with the computer manufacturer and the many problems which you can anticipate in terms of delivery dates, total costs, one-time charges, maintenance scheduling, and software or programming support.

The second is the problem of continuous on-the-job training of new employees. We have found that after establishing a critical mass of computer programmers, operators, coders, and psychologists we have been able to increase that mass by various on-the-job training techniques. Obviously, it is almost impossible to hire the services of trained CAI people.

As the final portion of my presentation this morning, I would like to discuss some alternative applications of CAI and a sample of the research studies which we have conducted at Florida State. These CAI studies have implications for the area of adult

education. I would like to return to the classification scheme proposed by Suppes; namely, drill and practice, tutorial, and problem solving. Although I spent some time discussing the tutorial mode, I would argue that the drill and practice mode would also have considerable application in areas of critically important learning skills in Adult Basic Education. The very nature of the CAI system makes it a very private learning situation in which the student can make numerous mistakes and the computer will continue to provide him with the type of material which he needs in order to master certain basic skills. The same situation repeated in a classroom could be embarrassing and humiliating. Moreover, computers have infinite patience and can even be supported in its interaction with the student.

At the other end of the Suppes continum is the area of problem solving. As I indicated earlier, we know much less about this type of application, but it does make sense to think of a medical student sitting down at a terminal and being given a set of symptoms for a patient and then being allowed to systematically take measurements and make diagnoses of possible illness which may be involved. The computer can provide feedback and information to assist in this problem solving task. Perhaps the analogue in Adult Basic Education or even with teenagers would be to provide real life problems in this mode, such as the utilization of money. The student could be placed in the position of a newlywed who has an income of $300 a month. What would this provide? For the teenager, the reality of the expenses and cost of being married might be a rude awakening, whereas for the welfare recipient,

this mode could be provided in order to help him realize more economic ways of utilizing his limited resources. I am sure that other imaginative uses of the problem solving mode could be devised in which the student engages in an interaction in which he utilizes his limited knowledge to engage in CAI problem solving.

Perhaps the most viable and immediate demand for computers in education, you may classify it as CAI if you like, is what is now being called computer-managed instruction, or CMI. If you consider closely our Physics project in which we used a variety of media, the computer played primarily a monitoring and evaluative role, and it is my understanding on the basis of reading the limited literature in the field, that this is what the majority of professionals would consider computer-managed instruction. That is, CMI is the overall management of learning materials and evaluation of students who are participating in a training program where the instruction is <u>not</u> primarily conducted by the computer, but through the use of other types of self-instructional materials. Project Plan of the American Institute for Research is one example of CMI and Glaser's work with Individually Prescribed Instruction, which now includes the implementation of a computerized monitoring system, is another. It is my observation that instruction in which objectives are set for the students and materials are provided to achieve those objectives is becoming more evident. A student may either select those objectives in a sequence which he feels is best for him or in a sequence prescribed by the computer. And the student is totally or partially evaluated by the computer on his acquisition of these objectives. It is a very significant step forward, not

simply in the utilization of computers in education, but in our philosophy of education per se.

In order to give you a concrete example of computer-managed instruction, I would like to take a few minutes to describe the graduate level course which will be conducted via CMI at Florida State this Fall. The name of the course is "Techniques of Programmed Instruction." The purpose of the course is to have students produce between 30 and 60 minutes of programmed instructional materials which have been developed in accordance with a Systems Approach model. In order to implement this course under computer-managed instruction, the content has been task analyzed and 20 primary tasks have been identified. For each task, there are from one to three objectives. Half the students will be given a set sequence of objectives which they must follow. The other half of the students will be able to select any objective or task which they feel is appropriate and proceed ahead. After choosing an objective, they will be given a list of the resource materials which are available to them in order to achieve the objective. For each task, there is basically a cognitive skill, such as proficiency in identifying the components of a behavioral objective, and a product such as actually writing behavioral objectives for the PI materials. Ultimately, the students will, through reading of materials, meeting in small groups, and requesting conferences with me, proceed to develop, evaluate, revise and again evaluate, their instructional materials.

The primary role of the computer in this CMI project will be to evaluate the students' performance on each of the cognitive

tasks and to maintain a continual record of where the students are in the course. Any requests by students for assistance can be raised with my graduate assistants or me. We will be analyzing both the role which I as a professor will play, and the ability of the computer to manage this relatively large class of 53 students. This is the only application I know of for computer-managed instruction in which the students will actually interact with the computer via a terminal, which is operating in real-time, or CAI mode. In other applications of CMI, the students simply take a test, have the test scored by the computer, and a report is either sent back to the student or to the teacher who determines their next instructional sequence. The CMI course which we will be implementing at Florida State is a rather small beginning effort to try to understand the variables and the complexities associated with computer-managed instruction.

A larger effort which may be more prototypic of total adult education training programs is one which we are mounting in the area of elementary teacher training. Florida State has been awarded a USOE contract to develop the second phase of a model for teacher training at the elementary level. The Florida State conception of this training relies heavily on individualized instruction. Present enrollment in this program at Florida State is approximately 800 to 900 students with projections that it can go as high as 1500 students. In order to implement an individualized program of this magnitude, it is clearly imperative that the computer be involved as a monitoring, scheduling and evaluative device. The

computer will continuously print reports for counseling or clinical professors in order that they may spend their time advising students in terms of the use of resources and of their time. The details of this model have not yet been worked out, but it is a challenging task and one in which the computer will be an invaluable tool.

Another application of CAI is in the process of testing. We have run several studies in which it is quite clear that, using a branching testing strategy based on test item characteristics, you can very quickly and efficiently test the students over a series of concepts without administering large batteries of questions. You can relatively quickly identify what their final level of performance will be. We have used the term "sequential testing" in terms of generally supplying the student with test items which approximate his level of performance on the just preceding item in the test. The test is specifically adapted to his performance as he proceeds through it. Therefore, this type of testing activity can be utilized in the same way that conventional tests are currently used. However, it is much shorter and quicker and has been shown to provide more reliable data.

Another interesting example using CAI in a testing mode is currently under way at Florida State in the Department of Social Welfare. This may have some application again to adult education. Students who typically enter the graduate Department of Social Welfare come from a great variety of backgrounds. The initial graduate courses are often trivial to some and over the heads of others, and it's very difficult to find a happy medium. A battery of test items is being established in the areas of Psychology and Sociology

which will be made available via CAI to students entering the Social Welfare Graduate Program. They will take these tests and will be systematically evaluated at various levels in order to determine their present understanding of various concepts. For certain levels of misunderstanding or lack of knowledge, remedial activity will take place at the terminal. For students with very poor performances, additional hardcopy materials will be made available and they will return and be tested later. It is anticipated that in this manner, students can be screened and placed in either remedial activities or regular courses appropriate to their entry skills in the program, and they will no longer be required to either participate in courses which are beyond their capabilities at the present time, or are relatively trivial on the basis of the extensive background experience which they have had.

Another successful utilization of CAI has been in the area of academic advising. A study of this application was conducted at the Tallahassee Junior College by one of our graduate students. He placed two terminals in the Junior College and programmed a sequence of information which it was felt would be of value to the students. This information included the rules and regulations of the junior college, information about the grading standards, information on the basic studies program, and on courses that were available and required within that program. There was also information available on transferring to various colleges in the Southeast as well as specific information on Florida State University. The purpose of the activity was to provide the student, through a dialogue like interaction with the computer, with information which he needed to better understand

the junior college and its rules and regulations and to get official unbiased information about the program.

The computer also provided the student with a listing of his current record at the junior college in terms of courses he had taken, grades he had received and his grade point average. On the basis of the information about the junior college curriculum and his junior college record, the student was requested to then list the courses which he would like to take during the next academic quarter. This information was stored in the computer and evaluated by the counseling team at the junior college. Approximately 85% of those schedules generated by the students were judged to be good or excellent by a faculty jury. The system was heartily accepted by both the students and the faculty members. This application is prototypic of the use of computers in a situation in which it is necessary to provide and receive accurate information from a large diverse population. I perceive this as a special case of a more general type of data acquisition system. This is an important application which will grow in junior colleges and college environments where it is critically important to the student that he receive accurate information and where faculty members are critically short of time to deal with all the students to the extent to which they deserve attention. It is anticipated that should such a system be implemented, human resourses could be utilized to deal with the more accute and deserving problems rather than simply to distribute information which is available from other sources.

I could summarize our simulated visit to the FSU CAI Center by indicating that I have discussed our experiences with the develop-

ment of course materials and those activities which seem to lead to successful performance both by our developmental staff and in turn by the students. I have briefly reviewed trends as we see them in the hardware which will be required to further CAI and the costs that are associated with that hardware. I have touched on some of the problems which are inevitable in terms of implementing CAI and have concluded with a description of some applications which we have tried to pursue within the capability of our CAI system. We feel that, being in a University environment, we still reserve a certain right to fail, and because of this right to fail we have been fortunate enough to also succeed in a number of areas. I hope the variety of these applications have been suggestive to you in terms of conveying our feeling that CAI is not simply a narrowly defined term referring to continual tutorial interaction between the computer and the student, but is a more generic term referring to all types of interaction between the student and the computer in pursuing worthwhile educational outcomes.

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13. ABSTRACT

This paper is an introduction to computer-assisted instruction for persons working in the area of Adult Basic Education. There is an extensive discussion of the development and evaluation of a tutorial CAI program. CAI hardware and implementation are also discussed. A variety of prototype computer applications, which have been investigated at Florida State, are described along with their implications for Adult Basic Education.

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